REMARKS

Rejections Under 35 USC §103(a)

Claims 170, 172, 173, 175-177, 264 and 270 have been rejected under 35 USC 103(a) as being obvious over Brooks (US Patent No. 5,496,775) in view of Farnworth et al. (US Patent No. 6,620,731) and "Moisture Absorption In No-Flow Underfill Materials And Its Effect On Interfacial Adhesion To Solder Mask Coated FR4 Printed Wiring Board" by Ferguson et al.

Claims 178, 262 and 265-267 have been rejected under 35 USC 103(a) as being obvious over Brooks (US Patent No. 5,496,775) in view of Farnworth et al. (US Patent No. 6,620,731) and "Moisture Absorption In No-Flow Underfill Materials And Its Effect On Interfacial Adhesion To Solder Mask Coated FR4 Printed Wiring Board" by Ferguson et al. and Kinsman et al. (US Patent No. 6,717,245).

Claims 171 and 268 have been rejected under 35 USC 103(a) as being obvious over Brooks (US Patent No. 5,496,775) in view of Farnworth et al. (US Patent No. 6,620,731) and "Moisture Absorption In No-Flow Underfill Materials And Its Effect On Interfacial Adhesion To Solder Mask Coated FR4 Printed Wiring Board" by Ferguson et al. and Beffa et al. (US Patent No. 6,233,185).

Claim 263 has been rejected under 35 USC §103(a) as being obvious over Brooks (US Patent No. 5,496,775) in view of Farnworth et al. (US Patent No. 6,620,731) and "Moisture Absorption In No-Flow Underfill Materials And Its Effect On Interfacial Adhesion To Solder Mask Coated FR4 Printed Wiring Board" by Ferguson et al. and Farnworth et al. (US Patent No. 6,097,087).

Claim 269 has been rejected under 35 USC 103(a) as being obvious over Brooks (US Patent No. 5,496,775) in view of Farnworth et al. (US Patent No. 6,620,731) and "Moisture Absorption In No-Flow Underfill Materials And Its Effect On Interfacial Adhesion To Solder Mask Coated FR4 Printed Wiring Board by Ferguson et al. and Lin (US Patent No. 5,436,203).

Claim 271 has been rejected under 35 USC 103(a) as being obvious over Brooks (US Patent No. 5,496,775) in view of Farnworth et al. (US Patent No. 6,620,731) and "Moisture Absorption In No-Flow Underfill Materials And Its Effect On Interfacial

Adhesion To Solder Mask Coated FR4 Printed Wiring Board by Ferguson et al. and "Functional And Smart Materials" by Wang.

The rejections under 35 USC §103(a) are traversed for the reasons to follow.

Summary Of Claimed Subject Matter

Claims 170-179 and 262-271 are directed to a semiconductor component 16 (Figures 4A-4C and 1K) which includes a thinned semiconductor die 10T (Figure 4C) having a circuit side 20 (Figure 4C), a thinned back side 22T (Figure 4C), and a plurality of peripheral edges 30 (Figure 4C). The component 16 (Figures 4A-4C) also includes a first polymer layer (circuit side polymer layer 36P (Figure 4C) and edge polymer layers 40 (Figure 4C) covering the circuit side 20 and the edges 30. The component 16 (Figures 4A-4C) also includes a second polymer layer (back side polymer layer 38P (Figure 4C)) covering the back side 22T.

The component 16 (Figures 4A-4C) also includes a plurality of die contacts 18 (Figure 4C) on the die 10T, and a plurality of contact bumps 24P (Figure 4B) on the die contacts 18 embedded in the first polymer layer 36P (Figure 4C). The component 16 (Figures 4A-4C) can also include terminal contacts 42 (Figure 4C) on the contact bumps 24P. As shown in Figure 8F, the component can also include conductive vias 70A (Figure 8F) in electrical communication with the die contacts 18, and terminal contacts 42A (Figure 8F) on the conductive vias 70A.

35 USC §103(a) Rejections Of Claims 170, 172, 173, 175-177, 264 and 270 Over Brooks, and Farnworth et al. And Ferguson et al.

The 35 USC §103(a) rejections of claims 170, 172, 173, 175-177, 264 and 270 over Brooks, Farnworth et al. and Ferguson et al. are traversed as the rejected claims *taken as a whole* are unobvious over the cited art. The test for obviousness is whether the teachings of the prior art, *taken as a whole*, would have made obvious the claimed invention. See *In re Young*, 927 F.2d 588, 591, 18 USPQ2d 1089, 1091 (Fed. Cir. 1991); *In re Keller*, 642 F.2d 413, 425, 208 USPQ 871, 88 (CCPA 1981).

Although individual features of the present component are known in the art, the claims *taken as a whole* are submitted to be unobvious over the art.

Brooks was cited as disclosing a semiconductor device having a die 30 with die contacts, a plurality of contact bumps 32 on the die contacts, a first polymer layer 36B covering the circuit side and edges of the die 30, and a second polymer layer 36A covering the backside of the die.

Farnworth et al. was cited as disclosing a semiconductor device with a thinned die 10 and conductive vias 34.

Ferguson et al. was cited as disclosing a polymer material comprising a self planarizing thermoset underfill film which is rigidifying.

Independent Claim 170

Independent claim 170 has been amended to remove the "self planarizing thermoset underfill film" recitation. Amended claim 170 recites the thinned die has "a selected thickness Ts". Antecedent basis for this recitation is contained in paragraph [0143] of the specification.

Amended claim 170 also recites "a first polymer layer planarized to a precise thickness Tcs". Antecedent basis for this recitation is contained in paragraph [0140], and paragraph [0161] last sentence.

Amended claim 170 also recites "a second polymer layer planarized to a precise thickness Tp". Antecedent basis for this recitation is contained in paragraph [0148], and paragraph [0163] last sentence.

Amended claim 170 also recites the first polymer layer comprises "a continuous layer covering the circuit side and the peripheral edges to the back side". Antecedent basis for this recitation is contained in paragraph [0164].

Each of the added recitations is submitted to further distinguish the claimed component from the prior art. In Brooks, the encapsulation material 36B (first polymer layer) is not planarized to a precise thickness, but rather is merely deposited on the die (column 3, lines 6-14). Also in Brooks, the encapsulation material 36A (second polymer layer) is not planarized to a precise thickness, but rather is merely deposited into a cavity bar holder 34 (column 2, line 58-61). Also in Brooks, the edge polymer layers are not "continuous" layers formed by the first polymer layer extending to the "back side" of the

die. Rather as shown in Figure 4 of Brooks, the edge polymer layers have a seam in the middle of the die.

One indicia of unobviousness is the new and improved results provided by the planarized sealing layers. In particular, the component has a precise thickness and all of the major surfaces are flat and parallel. In addition, the continuous edge polymer layers improves the hermetic sealing of the semiconductor die, as there is no seam along the edge. Further, the planarized sealing layers facilitate fabrication of the semiconductor component, because complicated molding equipment is not required.

The Examiner has characterized the "planarized" recitations as being "product by process" recitations having no patentable significance in a product claim. However, Applicant submits in the present claims, the "planarized" recitations are "structural" limitations, rather than "product by process" limitations. As stated in MPEP §2113, and as held in *In re Garnero*, 412 F.2d 276, 279, 162 USPQ 221, 223 (CCPA 1979): "terms such as "welded", "intermixed", "ground in place", "press fitted", and "etched" are capable of construction as structural limitations."

In the present component, the planarized sealing layers provide an improved component because the component has a precise thickness, and all the major surfaces of the component are flat and parallel. In addition, fabrication of the component is improved relative to conventional molded sealing layers, which require complicated molding equipment. Further, the continuous edge polymer layers do not have a seam, such that sealing is improved. Applicant submits that these facts meet the burden of proof requirement, demonstrating the unobviousness of the planarized sealing layer over conventional molded sealing layers.

Dependent Claim 172

Amended dependent claim 172 recites "the first polymer layer comprises a thermoset underfill film". As argued in the previous Amendment, an underfill material has not heretofore been used to encapsulate and seal the edges of a thinned semiconductor die. This material also provides new and unexpected results including improved encapsulation, improved edge rigidity, and improved fabrication.

Dependent Claim 173

Amended dependent claim 173 recites "the second polymer layer comprises a thermoset underfill film". As argued in the previous Amendment, an underfill material has not heretofore been used to encapsulate the back side of a thinned semiconductor die. This material also provides new and unexpected results including improved encapsulation and improved fabrication.

Dependent Claim 175

Amended dependent claim 175 recites "the thermoset underfill film has a cure temperature of about 200-250 °C, a Young's modulus of about 4G Pascal, and a coefficient of thermal expansion (CTE) of about 33 parts per million per °C". The prior art does not disclose a polymer layer having the stated characteristics for sealing the circuit side and edges of a thinned die. This material also provides new and unexpected results including improved encapsulation, improved edge rigidity, and improved fabrication.

Dependent Claim 176

Amended dependent claim 176 recites "the terminal contacts are arranged in a dense ball grid array (BGA)". Antecedent basis for this recitation is contained in paragraph [0162]. Although ball grid arrays are known in the art, their use in combination with the above recited elements of claim 170 is submitted to be novel and unobvious.

Dependent Claim 177

Dependent claim 177 recites "the die includes conductive vias in electrical communication with the die contacts and the contact bumps". This feature is submitted to be novel and unobvious in combination with the above recited elements of claim 170. This feature is further submitted to be unobvious for the reasons discussed in the previous Amendment.

Dependent Claim 264

Amended dependent claim 264 recites " the terminal contacts comprise ball bonds on the contact bumps". Antecedent basis for this recitation is contained in paragraph [0151]. This feature is submitted to be novel and unobvious in combination with the above recited elements of claim 170.

Dependent Claim 270

Amended dependent claim 270 recites "the second polymer layer comprises a thermoset underfill film having a cure temperature of about 200-250 °C, a Young's modulus of about 4G Pascal, and a coefficient of thermal expansion (CTE) of about 33 parts per million per °C". The prior art does not disclose a polymer layer having the stated characteristics for sealing the back side of a thinned die. This material also provides new and unexpected results including improved encapsulation and improved fabrication.

35 USC §103(a) Rejections Of Claims 178, 262 and 265-267 Over Brooks, Farnworth et al. Ferguson et al. and Kinsman et al.

Kinsman et al. was cited as disclosing bond pads (claim 178), solderable metal (claim 262), polymer filled trenches (claim 265), planar surface (claim 266) and polymer layers with different thicknesses (claim 267).

The 35 USC §103(a) rejections of claims 178, 262 and 265-267 over Brooks, Farnworth et al., Ferguson et al. and Kinsman et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170. These rejections are further traversed for the reasons discussed in the previous Amendment.

Also, claim 178 was listed as being withdrawn, but was included in the rejections. Accordingly, this withdrawal appears to be in error.

35 USC §103(a) Rejections Of Claims 171 and 268 Over Brooks, Farnworth et al., Ferguson et al. And Beffa et al.

Claims 171 and 268 recite that the thinned die comprises "a tested and burned in die". Beffa et al. was cited as disclosing a tested and burned in die.

The 35 USC §103(a) rejections of claims 171 and 268 over Brooks, Farnworth et al., Ferguson et al. and Beffa et al. are traversed for essentially the same reasons discussed above with respect to independent claim 170. These rejections are further traversed for the reasons discussed in the previous Amendment.

35 USC §103(a) Rejections Of Claim 263 Over Brooks, Farnworth et al., Ferguson et al. And Farnworth et al.

Claim 263 has been amended to recite "the terminal contacts and the contact bumps having a height selected to provide a desired spacing for flip chip mounting the component". Antecedent basis for this recitation is contained in paragraph [0152]. This recitation is submitted to further distinguish the claimed component from the cited art.

35 USC §103(a) Rejections Of Claim 269 Over Brooks, Farnworth et al., Ferguson et al. And Lin

Claim 269 recites "the die is contained on a semiconductor wafer having a polymer support dam proximate to edges thereof". Lin was cited as disclosing a polymer support dam.

The 35 USC §103(a) rejections of claim 269 over Brooks, Farnworth et al., Ferguson et al. and Lin is traversed for essentially the same reasons discussed above with respect to independent claim 170. These rejections are further traversed for the reasons discussed in the previous Amendment.

35 USC §103(a) Rejections Of Claim 271 Over Brooks, Farnworth et al., Ferguson et al. And Wang

Claim 271 recites "the second polymer layer comprises parylene". Wang was cited as disclosing "a semiconductor device that has parylene".

The 35 USC §103(a) rejections of claim 271 over Brooks, Farnworth et al., Ferguson et al. and Wang is traversed for essentially the same reasons discussed above with respect to independent claim 170. These rejections are further traversed for the reasons discussed in the previous Amendment.

Conclusion

In view of the amendments and arguments, favorable consideration and allowance of claims 170-179 and 262-271 is respectfully requested. An Information Disclosure Statement is being filed concurrently with this Amendment. Should any issues remain, the Examiner is asked to contact the undersigned by telephone.

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